NON-PUBLIC?: N
ACCESSION #: 9306170319
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Washington Nuclear Plant - Unit 2 PAGE: 1 OF 8

DOCKET NUMBER: 05000397

TITLE: REACTOR SCRAM AND HIGH PRESSURE CORE SPRAY (HPCS) SYSTEM
SUCTION VALVE TRANSFER DUE TO LOSS OF A REACTOR FEEDWATER PUMP CAUSED BY A FAILURE OF THE TURBINE GOVERNOR CONTROL SYSTEM
EVENT DATE: 02/10/93 LER #: 93-007-01 REPORT DATE: 06/11/93

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 94

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: H SYSTEM: CH COMPONENT: MECF MANUFACTURER: W290
REPORTABLE NPRDS: YES

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On February 10, 1993, at 1727 hours, a low Reactor Pressure Vessel (RPV) level reactor scram was initiated by the Reactor Protection System (RPS) in response to an actual low water level condition. The low RPV level was caused by the loss of Reactor Feedwater (RFW) Pump 1B due to a loss of turbine governor control.

At 1730 hours, steam was observed at the entrance to RFW Pump Room "B", and at 1739 hours, the steam supply to the RFW Pump 1B turbine was isolated. An Unusual Event was declared at 1750 hours to enhance increased awareness of plant personnel. Investigation of the steam in the pump room determined the source to be an RFW Pump 1B suction side relief valve and pump casing drain line.

At approximately 1800 hours, an unplanned Engineering Safety Features (ESF) automatic High Pressure Core Spray (HPCS) suction valve switchover occurred due to an actual high Suppression Pool water level. The high water level resulted from Main Steam Relief Valve (MSRV) discharge to the Suppression Pool during manual actuation for RPV pressure reduction.

The immediate corrective actions were prompt response by Plant Operators to bring the plant to a safe shutdown condition, and to restore HPCS suction to the normal configuration.

Abstract (Cont'd)

The root cause of this event was less than adequate evaluation of corrective actions to prevent recurrence of RFW pump turbine governor actuator connector pin corrosion and failure. Further corrective actions will perform a failure analysis of the connector and implement action(s) to eliminate the connector pin corrosion.

This event posed no threat to the health and safety of either the public or plant personnel.

END OF ABSTRACT

Plant Conditions

Power Level - 94 %
Plant Mode - 1 (Power Operation)

Event Description

At 1727 hours on February 10, 1993, Control Room Operators received annunciators indicating low Reactor Feedwater (RFW) Pump 1B discharge flow and turbine coastdown (minimum speed). At 17:27:38 hours, a low Reactor Pressure Vessel (RPV) level reactor scram was initiated by the Reactor Protection System (RPS) in response to an actual low water level condition. The low RPV level was caused by the loss of the RFW pump due to a loss of turbine governor control. Post scram actions were initiated and the Emergency Operating Procedures (EOPs) were entered to restore RPV water level using the Reactor Core Isolation Cooling (RCIC) system. The lowest transient RPV level reached was -19 inches at 17:28:17 hours.

At 1728 hours, the control room received an RFW Pump Room "B" fire alarm, and an Equipment Operator (EO) was dispatched to the area. At 1730

hours, the EO reported the presence of steam at the entrance to Pump Room "B". At 1739 hours, in response to the unknown steam source, the steam supply to the RFW Pump 1B turbine was isolated. At 1740 hours, the Control Room Operators broke main condenser vacuum, then immediately closed the Main Steam Isolation Valves (MSIVs) and the main steam to auxiliaries cross-connect valve (MS-V-146).

Between 1749 hours and 1924 hours, the Main Steam Relief Valves (MSRVs) were manually actuated for gradual plant pressure reduction to 500-600 psig in anticipation of utilizing the Condensate Booster Pumps for RPV level control. Approximately one minute after actuation of the first MSRV, a Suppression Pool high level alarm was received in the Control Room due to an actual high level condition of +0.65 inches (0 inches is normal level). The high water level resulted from MSRV discharge to the Suppression Pool during manual actuation for RPV pressure reduction.

An Unusual Event was declared at 1750 hours to enhance increased awareness of plant personnel.

At 1800 hours, the Shift Support Supervisor and a Health Physics Technician entered RFW Pump Room "B" and observed steam and water blowing out of a floor drain at the South end of the room. Further investigation determined the source to be a pump suction relief valve (COND-RV-183B) and pump casing drain line. The pump was subsequently isolated to stop the leaks. No abnormally high radiation levels were recorded in the pump room.

At approximately 1800 hours, while Plant Control Room Operators were actuating the MSRVs to reduce RPV pressure, an unplanned Engineering Safety Features (ESF) automatic High Pressure Core Spray (HPCS) suction valve switchover occurred due to an actual high Suppression Pool water level. HPCS suction was in the normal configuration at the time of the valve switchover, with Condensate Storage Tank (CST) Suction Valve HPCS-V-1 open and Suppression Pool Suction Valve HPCS-V-15 closed. The automatic HPCS suction valve switchover closed HPCS-V-1 and opened HPCS-V-15 when the Suppression Pool water level reached approximately +3 inches.

At 1808 hours, in response to the Suppression Pool high level alarm and automatic HPCS suction valve switchover, Residual Heat Removal (RHR) Pump 2B was placed in service for Suppression Pool cooling, and letdown to the Radioactive Waste (Radwaste) system was initiated to lower the Suppression Pool water level.

At 1904 hours, Plant Control Room Operators reset the RPV Low Level Scram. The Unusual Event was terminated and the EOPs were exited at 1905 hours.

The MSIVs and the main steam to auxiliaries cross-connect valve were re-opened between 2007 hours and 2107 hours. At 2120, this event was terminated by reactor pressure control being transferred to the Main Turbine Bypass Valves and RPV level being controlled by the Start-up Flow Control Valves in automatic.

Immediate Corrective Actions

Plant Operators responded promptly to the post scram RPV water level and pressure transients to bring the plant to a safe shutdown condition using appropriate plant procedures. Plant Control Room Operators responded to the HPCS suction valve transfer by lowering the Suppression Pool level when plant conditions allowed, and restoring HPCS suction to the normal configuration.

Further Evaluation and Corrective Action

Further Evaluation

1. In accordance with 10CFR50.72(b)(2)(ii), this event was reported to the NRC Operations Center via the Emergency Notification System (ENS) at 1910 on February 10, 1993, as an unplanned automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS). This event is also reportable under 10CFR50.73(a)(2)(iv) as any event or condition that resulted in a manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS).

2. Troubleshooting determined the cause of the RFW Pump 1B turbine coastdown to be corrosion of the Woodward governor servo-motor actuator control 4-pin connector pins. The governor actuator uses RFW pump turbine lube oil for control oil and lubrication. A significant amount of water was found in the governor actuator, which apparently caused erosion of the connector pins by destructive oxidation corrosion or pitting due to electrical arcing. Water intrusion into the 4-pin connector, would act as the oxidizing agent, in the case of oxidation corrosion, or the ground path, in the case of electrical pitting. The source of the water in the turbine oil system is most likely the system interfaces with the turbine seal steam and pump seal water systems. The governor

actuator appears to act like a condensing pot for the seal steam due to its mounting location at the high point of the turbine lube oil system and its relatively cool air space. The steam condenses and concentrates in the governor actuator, with the 4-pin connector being exposed, and finally immersed, in the water due to its mounting location on the actuator.

3. A precursor condition may have occurred on January 27, 1989, when the RFW Pump 1B turbine governor actuator caused turbine speed oscillations. However, no root cause evaluation or failure analysis was performed because maintenance practices at the time only addressed replacement of the faulty governor and its return to the manufacturer for refurbishment.

4. This connector pin corrosion condition appeared once before on February 20, 1991 Ref: Material Deficiency Report (MDR) 291-129!. The corrective actions for this MDR were the installation of oil clarifier/purifiers to remove moisture from the RFW pump turbine oil and the replacement interval for governor actuators being reduced to every two years.

5. The clarifier/purifiers were installed in 1991 during the R-6 refueling outage, but failed to remove enough water from the turbine oil to prevent recurrence of the connector pin corrosion. Further investigation indicates that complete elimination of the water in the turbine oil is not easily achievable. Therefore, the next best course of action is to eliminate the water intrusion into the connector.

In accordance with the two year replacement schedule established for MDR 291-129, the governor actuators were scheduled for replacement during the upcoming R-8 refueling outage commencing in April 1993. The premature connector pin corrosion failure was apparently due to the replacement schedule being selected without an adequate evaluation of the factors affecting the corrosion rate.

6. During a loss of one RFW pump, the Reactor Recirculation (RRC) System is designed to initiate an automatic RRC Flow Control Valve (FCV) Runback to reposition the "A" and "B" FCVs to 25% open. This action reduces reactor power and steam flow to within the capacity of the remaining feedwater pump. However, during this event, the automatic runback system was not initiated, and the remaining RFW pump (1A) was unable to supply enough water to maintain RPV level

above the reactor scram setpoint. The post scram investigation determined that the permissives for automatic runback initiation had not been met. The control logic requires an RFW Pump turbine trip signal and a low RPV level signal of +30 inches (Level 4) and a Reactor Recirculation (RRC) pump in fast speed. During this event, there was no turbine trip signal generated coincident with the low RPV level and the RRC pump fast speed signals. The loss of RFW Pump 1B was due to a turbine coastdown condition caused by the loss of governor control, for which there is no trip signal associated.

7. During the coastdown of RFW Pump 1B, RFW Pump 1A remained in operation. This caused a differential pressure of approximately 400 psi to be developed across the Pump 1B discharge check valve, resulting in an abrupt closure. The sudden pump discharge isolation caused a suction pressure excursion, lifting Suction Relief Valve COND-RV-183B at approximately 775 psi. The high temperature condensate being released to the RFW Pump Room "B" floor drain immediately flashed to steam. This produced the steam observed at the entrance to the pump room.

8. Plant Annunciator Response Procedures PPM 4.601.A11 and 4.601.A12, "Annunciator Panel Alarms" for Suppression Pool Level, require that when level is greater than +0.5 inches, Plant Control Room Operators are to lower Suppression Pool level by means of aligning the Residual Heat Removal (RHR) system to the Radwaste system, or manually switchover the HPCS suction valves to preclude an inadvertent ESF actuation. As a result of a previous event (LER 90-014), the procedure also included a caution that an automatic HPCS suction valve transfer could occur as early as +3.0 inches (the setpoint is +5.0 inches) due to instrument inaccuracy. However, according to Plant Procedure PPM 1.3.1, Conduct of Operations, EOPs have priority/precedence over Plant Annunciator Response Procedures.

9. The Plant Control Room Operators acknowledged the Suppression Pool high water level alarm, but at the time, they were focusing on the higher priority actions required by the EOPs. As a result, they did not manually switchover the HPCS suction valves in time to avoid the automatic actuation. They were, however, able to initiate letdown to lower the Suppression Pool water level, in accordance with required EOP actions. But, the response was not in time to prevent the level from increasing to the Suppression Pool high level setpoint for the automatic HPCS suction valve switchover. This was due to the relatively high discharge flow rates from the MSRVs to the Suppression Pool during the period of RPV pressure reduction,

and the time and manpower constraints of EOP actions. The highest indicated Suppression Pool level was + 4.7 inches, which was below the required setpoint value of +5.0 inches, and well below the Safety Relief Valve (SRV) Tail Pipe Level Limit specified in the EOPs. The HPCS suction valve switchover is considered by Operations Management to be a consequence of EOP directed actions for MSRV initiation to reduce RPV pressure, and was properly addressed by Plant Control Room Operators on a lower priority.

Root Cause

The root cause of this event was less than adequate evaluation of corrective actions under MDR 291-129 to prevent recurrence of the connector pin corrosion. The previous evaluation failed to determine all of the factors affecting the connector pin corrosion and recommend corrective actions to prevent recurrence.

Further Corrective Action

1. The initial remedial actions were to replace the Woodward governor actuators on RFW Pump 1A and 1B under Maintenance Work Requests (MWRs) AP2418 and AP2397, respectively.

2. Perform a failure analysis of the RFW Pump 1B turbine governor actuator 4-pin connector to confirm the suspected failure modes of oxidation corrosion or electrical pitting caused by water in the oil. This action to be completed by April 30, 1993.

3. Based upon the results of the failure analysis of the RFW Pump 1B turbine governor actuator 4-pin connector and applicable industry experience, evaluate alternative resolutions using TER 93-0055. Select and implement a course of action to eliminate the connector pin corrosion by the completion of the upcoming R-8 refueling outage. Assess the effectiveness of the action(s) at the completion of the R-9 refueling outage.

4. No further corrective action is required in response to the inadequate evaluation since additional staff training has been accomplished.

Safety Significance

All systems operated as designed for a loss of one RFW Pump due to a turbine coastdown (no trip signal). In addition, Plant Operators

responded promptly to the post scram RPV water level and pressure transients to bring the plant to a safe shutdown condition using appropriate plant procedures. Although an actual RPV low level did exist for a short period, with vessel level decreasing to - 19 inches, the transient was well within the bounds of WNP-2 safety analysis. Furthermore, Plant Control Room Operators responded properly to the HPCS suction valve transfer by lowering the Suppression Pool level when plant conditions allowed, and realigning HPCS suction to the pre-event lineup. Suppression Pool level was maintained well below the "SRV Tail Pipe Level Limit (SRVTPLL)" to preclude SRV system damage. Accordingly, this event posed no threat to the health and safety of either the public or plant personnel.

Similar Events

There were no previous events at WNP-2 in which a reactor scram occurred due to an RFW Pump coast down with no turbine trip. There also were no previous events in which a HPCS suction valve transfer occurred as a consequence of EOP directed actions. There was, however, a previous nonreportable occurrence of a corrosion failure of an RFW pump turbine governor actuator connector pin on February 20, 1991 (MDR 291-0129).

EIIS Information

Text Reference EIIS Reference
System Component

Reactor Pressure Vessel AC RPV
Reactor Recirculation (RRC) System AD FU
Reactor Protection System JC ---
Reactor Feedwater Pump Turbine 1A SJ TRB
Reactor Feedwater Pump Turbine 1B SJ TRB
Reactor Feedwater I&C System JK ---
Reactor Feedwater Control System JB CAP
Reactor Recirculation Flow Control Valve AD FCV
Reactor Recirculation Pump AD P
High Pressure Core Spray (HPCS) System BG ---
HPCS-V-1 BG V
HPCS-V-15 BG V
Suppression Pool NH ---
Condensate Storage Tank KA TK
Main Steam Relief Valves (MSRVs) SN RV
Residual Heat Removal (RHR) Pump BO P
Feedwater Pump Turbine Governor JK 65

Main Steam Isolation Valves (MSIVs) SB ISV
Reactor Core Isolation Cooling (RCIC) System BN ---
Annunciator IB LA
Main Turbine Bypass Valves JI V
Start-Up Flow Control Valves AC FCV
Turbine Lube Oil Clarifier TD CLF
Turbine Lube Oil Purifier TD PFR
Condensate Booster Pump SD P

ATTACHMENT 1 TO 9306170319 PAGE 1 OF 1

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

P.O. Box 968 o 3000 George Washington Way o Richland, Washington 99352

June 11, 1993
G02-93-154

Docket No. 50-397

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: NUCLEAR PLANT WNP-2, OPERATING LICENSE NPF-21
LICENSEE EVENT REPORT NO. 93-007-01

Transmitted herewith is Licensee Event Report No. 93-007-01 for the WNP-2 Plant. This report is submitted in response to the report requirements of 10CFR50.73 and incorporates only minor administrative changes.

Sincerely,

J. V. Parrish (Mail Drop 1023)
Assistant Managing Director, Operations

JVP/CDM/jd
Enclosure

cc Mr. B. H. Faulkenberry, NRC - Region V
Mr. R. Barr, NRC Resident Inspector (Mail Drop 901A, 2 Copies)
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